



# The Wildland Fire Emissions Information System:

Providing information for carbon cycle studies with open source GIS tools

Nancy HF French, Tyler A. Erickson, Donald McKenzie, Michael Billmire, Charles Hatt



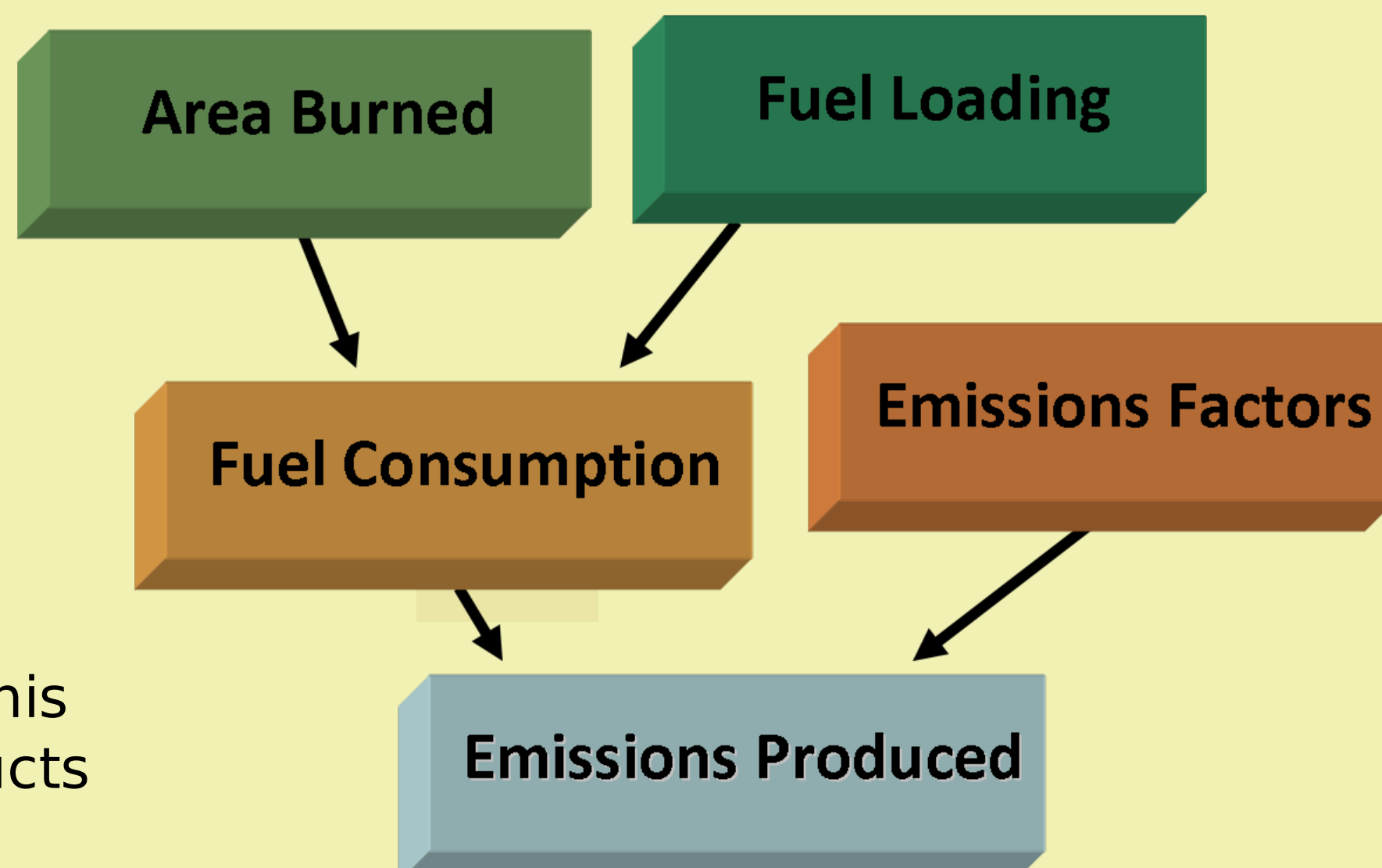
Michigan Tech Research Institute (MTRI)  
Michigan Technological University  
3600 Green Court, Suite 100 - Ann Arbor, MI 48105  
(734) 913-6840 Phone - (734) 913-6880 Fax - [www.mtri.org](http://www.mtri.org)

Fire and Environmental Research Applications Team (FERA)  
Pacific Wildland Fire Sciences Laboratory  
400 N 34th Street, Suite 201 - Seattle, WA 98103  
(206) 732-7800 Phone - [www.fs.fed.us/pnw/fera/](http://www.fs.fed.us/pnw/fera/)

## Project Overview

Four factors (see figure below) are needed to estimate carbon emissions from fire. The project underway will provide these data via a web-based information system built with open source GIS tools so users will have the latest and most accurate data modelling emissions from wildland fire.

A major goal of the North American Carbon Program is to resolve uncertainties in the carbon cycle of North America. As carbon modeling tools become more comprehensive and spatially oriented, accurate datasets to spatially quantify sources of carbon emissions from fire are needed. NASA is funding this project to develop improved products for modeling and estimating fire emissions across North America and to develop a prototype information system for disseminating this information to users who manage carbon or model the carbon cycle. The Wildland Fire Emissions Information System (WFEIS) described here will provide information for mapping fire-derived carbon emissions using NASA data and products and by adapting existing Forest Service fire information products and tools.



**AREA BURNED:** Will be obtained from MODIS-based burn area products and other sources of fire perimeter data, such as the Monitoring Trends in Burn Severity (MTBS) project or historic fire polygon datasets such as the Alaska and Canada Large Fire Databases.

**FUEL LOADING:** Improved maps of the USDA Forest Service's Fuels Characterization Classification System (FCCS) will be developed to describe and map fire fuels across the U.S. and Mexico. Canadian fuel types will be used for Canada.\*\*

**FUEL CONSUMPTION:** The CONSUME 3.0 emissions model, developed by the USDA Forest Service, and the Canadian fire emissions model, BORFIRE, will be used to help determine continent-wide fuel consumption and emissions.\*\*

**EMISSIONS FACTORS:** Based on published data.

\*\*For more information on fuel loading and consumption, see poster #123 - McKenzie and Ottmar, "Fuel loading and consumption models for assessing carbon release from wildland fires"

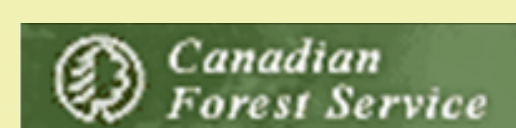
## Expected Users & Outcomes

Fire emissions modeling frameworks, such as *FLAMBE*, and carbon assessment tools developed through the North American Carbon Program, such as *Carbon Tracker*, provide a context for development of fire emissions datasets and a user-accessible information system to disseminate fire emissions products to end users. A user advisory group has been called-upon to help define needed information products and assess and improve the functionality of the information system. The group is comprised of people who represent end users, such as carbon modelers, atmospheric scientists working to understand the impact of fire on the atmosphere, and regulatory groups interested in tools to improve fire emissions estimates.

The emissions data sets and information will be provided at a 1 km spatial resolution and have relevance for understanding fire-affected carbon cycling at regional scales for the North American continent. Products and results will be consistent across international borders, although product reliability will inevitably vary due to availability of field and remote sensing data needed to create and validate the products.

## Collaborators

**Nancy HF French**, MTRI  
Primary Investigator  
**Tyler Erickson**, MTRI  
Co-Investigator



**Don McKenzie**, US Forest Service, FERA  
Co-Investigator

**Roger Ottmar**, US Forest Service, FERA  
Co-Investigator

**Ernesto Alvarado**, US Forest Service, FERA  
Collaborator

**Bill de Groot**, Canadian Forest Service  
Collaborator

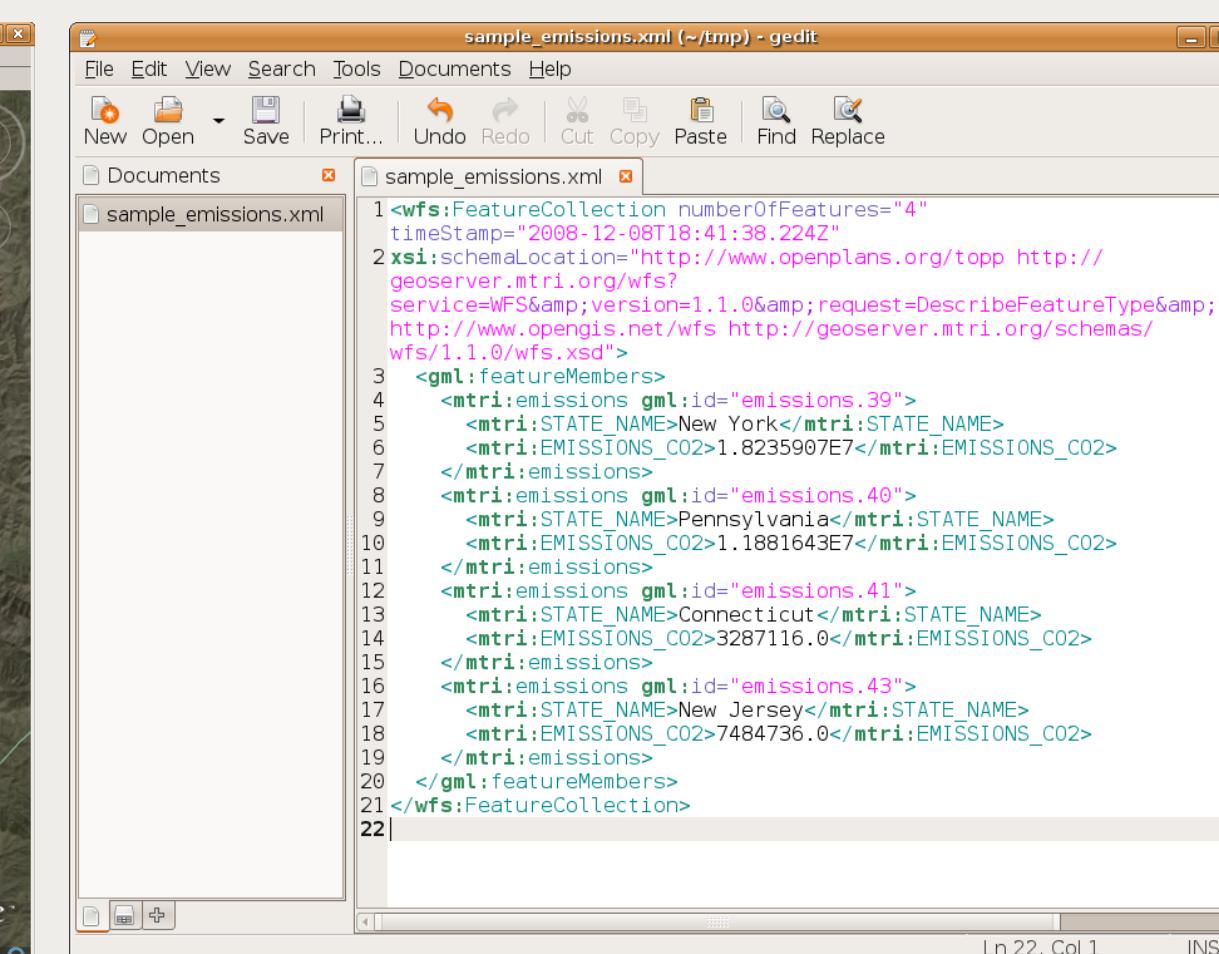
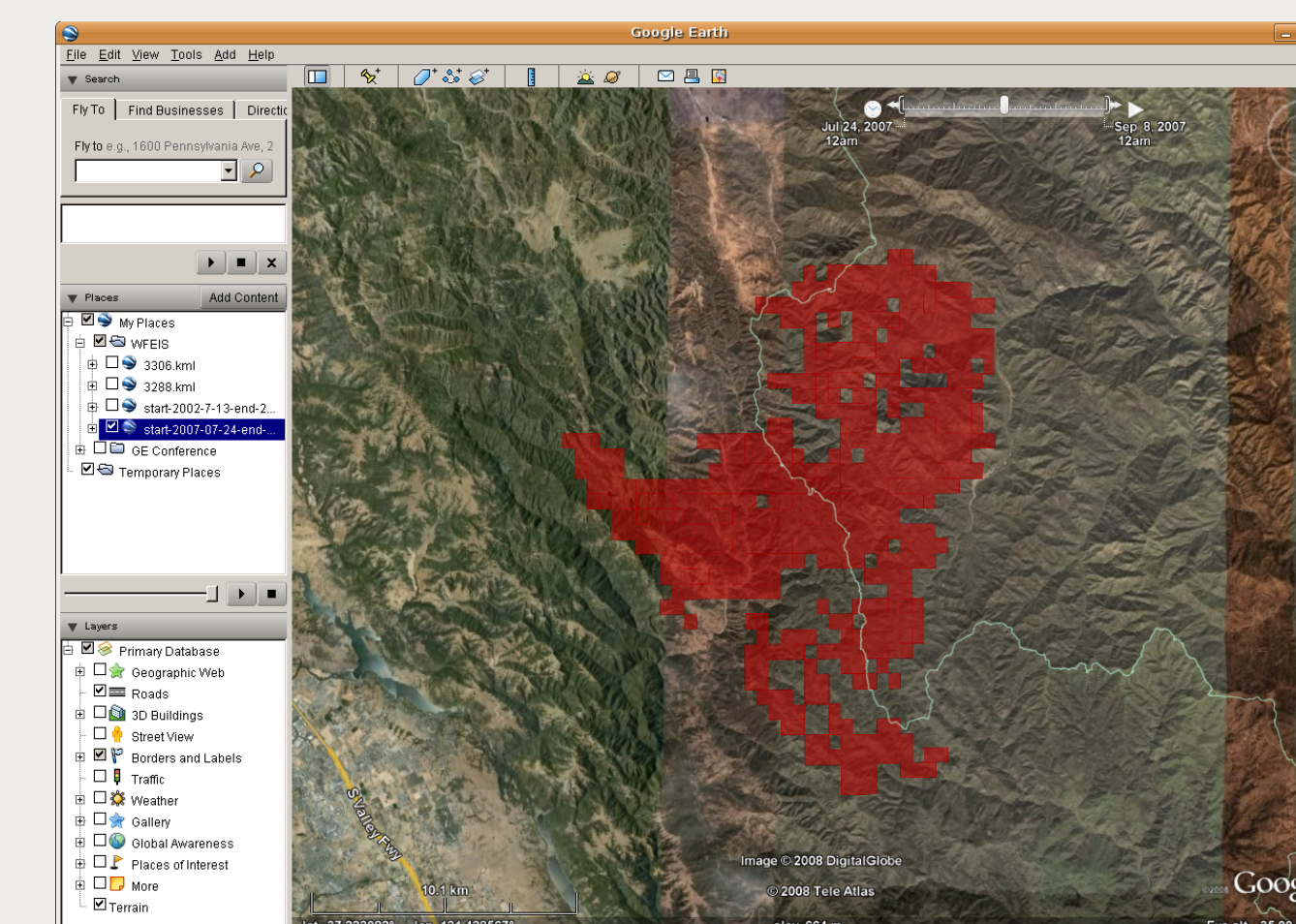
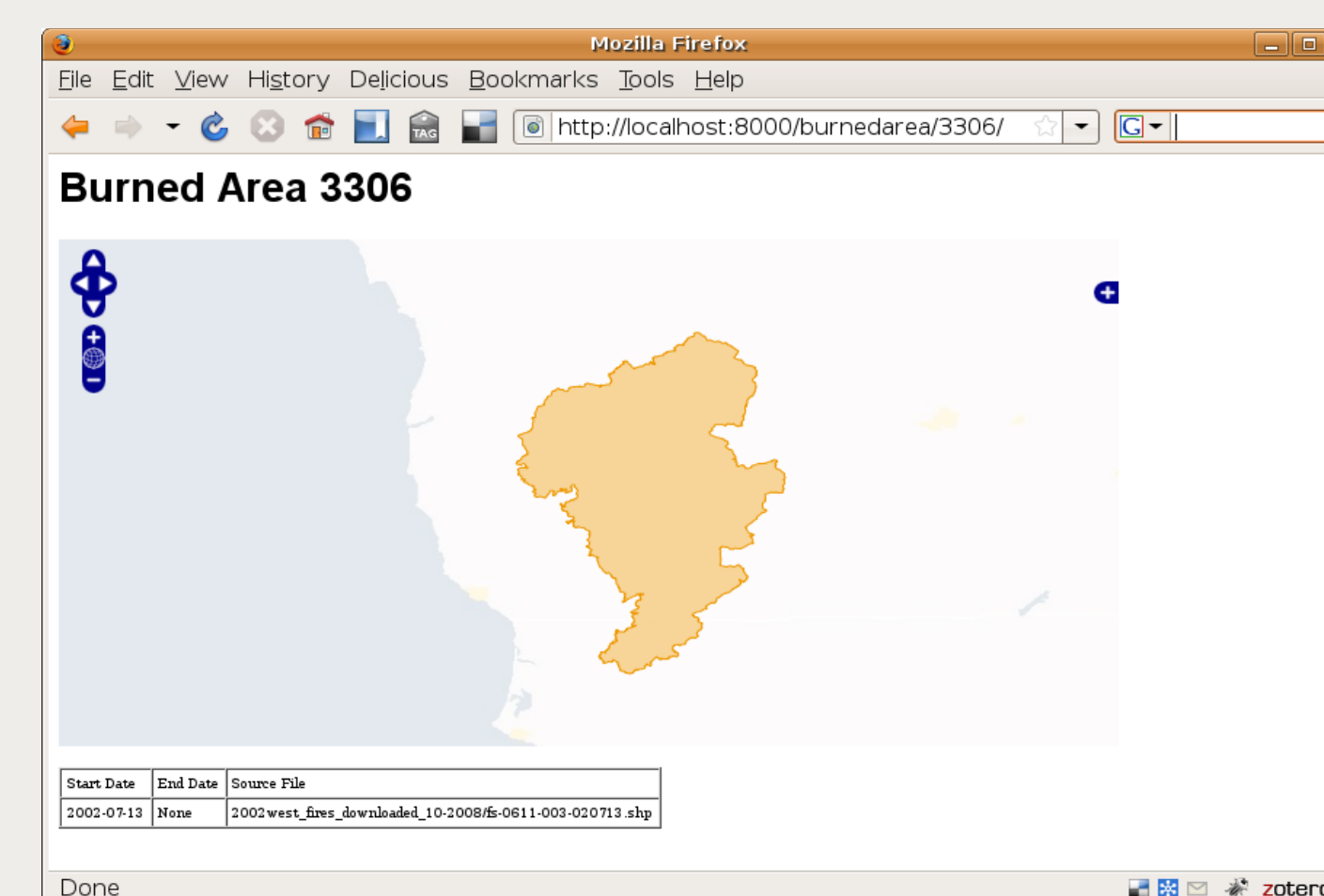
**Eric S. Kasischke**, University of Maryland  
Co-Investigator

## Information System Design & Development

### Client Interface

Dynamic  
Browser  
Web Pages

**Data Products**  
(Fire Perimeter /Fuel Loading / Consumption / Emissions)  
**provided in standard geospatial data formats**  
(examples: OGC KML, WMS, NetCDF, SHP)



### Application Servers

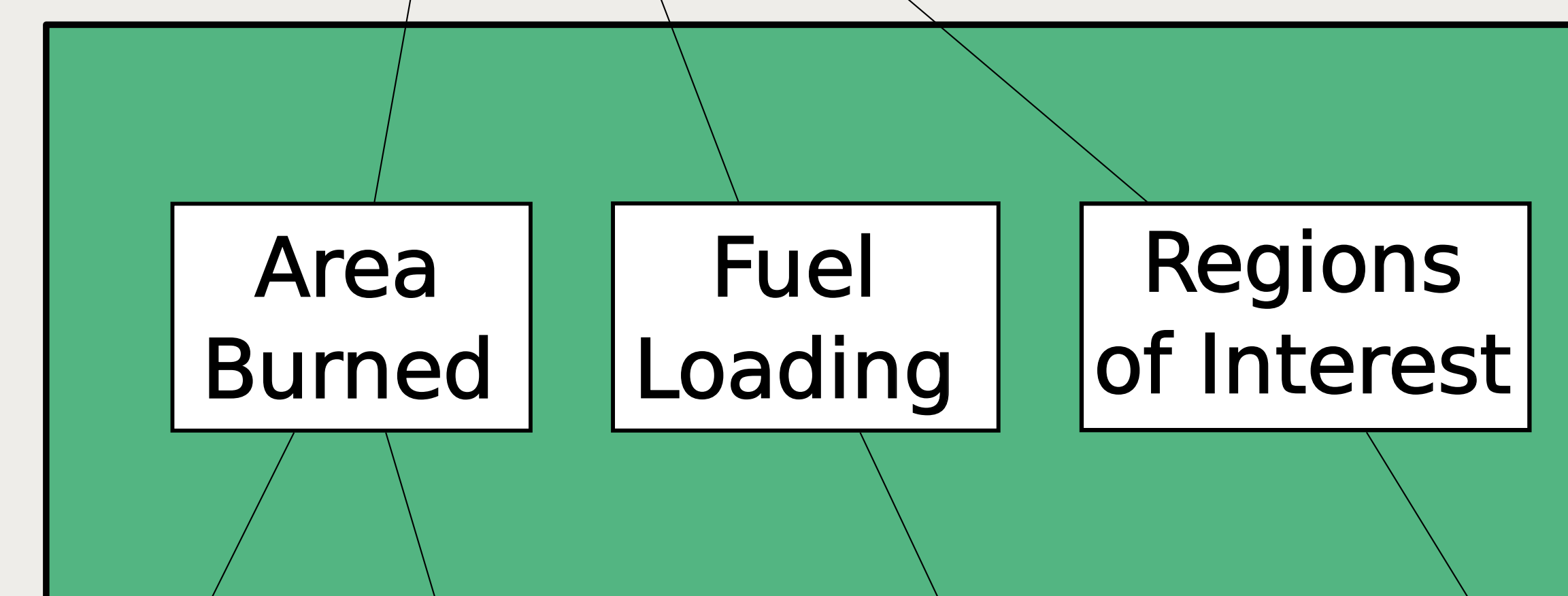


### WFEIS Web Framework

Emissions Model

Consumption Model

### Geospatial Database



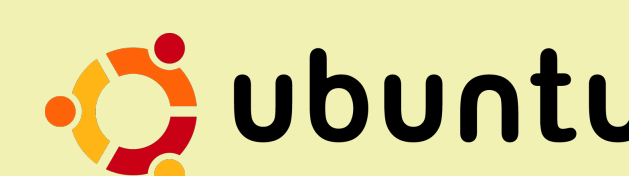
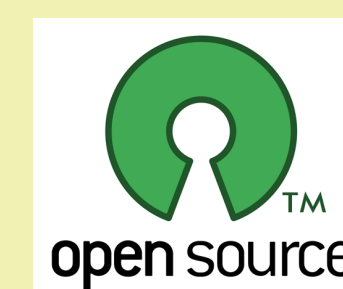
### Data Sources



## Open Source Software Utilized

The following publicly available data sources are used:

Source	Role	URL
NASA MODIS Burned Area Products	fire perimeter polygons	<a href="http://modis-fire.umd.edu/MCD45A1.asp">http://modis-fire.umd.edu/MCD45A1.asp</a>
USGS MTBS Burn Severity Fire Perimeters	fire perimeter polygons	<a href="http://mtbs.gov">http://mtbs.gov</a>
OpenStreetMap	reference basemap	<a href="http://openstreetmap.org">http://openstreetmap.org</a>



\*Open Source Initiative (OSI) approved licenses (<http://www.opensource.org>)  
^Open Source Geospatial Foundation (OSGeo) projects (<http://www.osgeo.org>)

The following table contains a list of open source software used by this project:

Component	Role	URL	License
Ubuntu Linux	operating system	<a href="http://www.ubuntu.com/">http://www.ubuntu.com/</a>	GNU GPL* + various
Apache HTTP Server	web server	<a href="http://httpd.apache.org/">http://httpd.apache.org/</a>	Apache License v2.0*
GeoDjango	python-based geographic web framework	<a href="http://geodjango.org/">http://geodjango.org/</a>	BSD*
GDAL/OGR^	raster/vector translator library	<a href="http://www.gdal.org/">http://www.gdal.org/</a>	X/MIT*
GEOS^	geometry functions and operators library	<a href="http://trac.osgeo.org/geos/">http://trac.osgeo.org/geos/</a>	GNU LGPL*
Proj.4^	cartographic projection library	<a href="http://trac.osgeo.org/proj/">http://trac.osgeo.org/proj/</a>	MIT*
GeoTools^	Java GIS toolkit	<a href="http://geotools.codehaus.org/">http://geotools.codehaus.org/</a>	GNU LGPL*
GeoServer	geospatial data server	<a href="http://geoserver.org">http://geoserver.org</a>	GNU GPL*
OpenLayers	browser mapping framework	<a href="http://openlayers.org/">http://openlayers.org/</a>	Metacarta (BSD-style)
PostgreSQL	client-server relational database	<a href="http://www.postgresql.org/">http://www.postgresql.org/</a>	BSD*
PostGIS	geographic object extension for PostgreSQL	<a href="http://postgis.refractory.net/">http://postgis.refractory.net/</a>	GNU GPL*
Python	dynamic object-oriented programming language	<a href="http://www.python.org">http://www.python.org</a>	Python license*